

MEA 2015–16

Science Grade 11

The table below shows the entire eleventh-grade science test design. Scores are based on common items only, half of which are released and can be found in this document.

Test Design

CONTENT AREA	COMMON		FIELD TEST ITEMS		TOTAL ITEMS PER STUDENT		BASE TESTING TIME	POINTS
	MC	CR	MC	CR	MC	CR		
SCIENCE	40	4	8	1	48	5	120 MIN.	56

Each item on the MEA measures a content standard of Maine's 2007 *Learning Results*.

Science Content Standards Assessed on the MEA

D. The Physical Setting

1. Universe and Solar System
2. Earth
3. Matter and Energy
4. Force and Motion

E. The Living Environment

1. Biodiversity
2. Ecosystems
3. Cells
4. Heredity and Reproduction
5. Evolution

Item Information Chart

Please refer to the item information chart on the next page for in-depth information on each science released item. The released item numbers in the chart correspond to item numbers in the practice test and on the MEA Item Analysis Report.

Constructed-Response Scoring Guides

A constructed-response scoring guide includes score point descriptions used to determine the score. Training notes that follow the scoring guide provide in-depth descriptions or particular information also used to determine the score.

Student Work

At least one sample student response is provided for each score point with annotations that explain the reasoning behind the assigned score.

Grade 11 Science Released Item Information

Released Item Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Practice Test Page Number	1	1	1	1	2	2	2	2	2	3	3	3	4	4	4	4	5	5	5	5	6	7
Content Strand (Maine 2007 Learning Results)	E2	D3	E3	D2	D2	D4	D1	D4	D3	E2	E5	D3	E5	D4	D1	D3	E3	E2	D1	D3	E4	D2
Depth of Knowledge Code	1	2	2	2	2	1	1	2	1	3	2	1	2	2	1	3	1	2	3	2	3	2
Item Type	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	CR	CR
Possible Points	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4
Answer Key	C	D	A	B	D	D	B	D	D	C	B	A	B	C	D	D	D	B	B	D		
% Who Chose A or Earned 1 Point	4	9	58	16	6	5	5	36	7	13	9	58	11	9	14	19	10	19	17	17	20	25
% Who Chose B or Earned 2 Points	18	18	15	65	12	17	49	16	18	15	48	12	76	27	8	30	17	53	37	18	27	16
% Who Chose C or Earned 3 Points	77	12	6	7	3	10	40	12	23	66	17	10	6	42	23	13	41	10	22	42	26	24
% Who Chose D or Earned 4 Points	1	60	20	11	79	68	6	36	51	5	25	19	6	21	54	37	31	17	22	23	15	19
Statewide Average Student Score																					1.4	1.46

Content Strands: See “MDOE Regulation 132–Learning Results: Parameters for Essential Instruction” at

<http://www.maine.gov/education/lres/pei/index.html>.

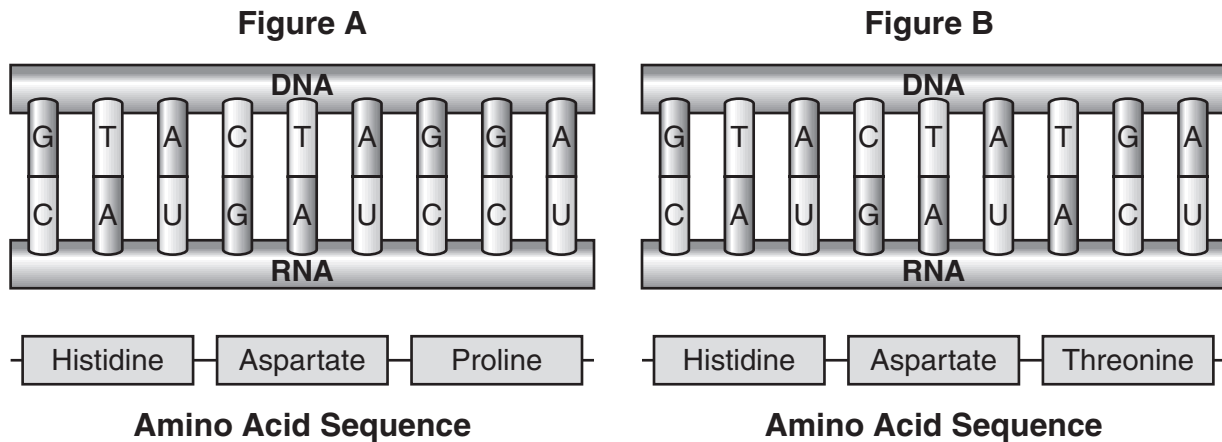
Item Type: MC = multiple choice, CR = constructed response

Answer Key: the letter of the correct answer choice

MEA Science Grade 11 Released Items – Student Work

Constructed-Response Item 21

21. Figure A shows the DNA, RNA, and amino acids associated with the expression of part of a gene sequence. Figure B shows the same information for a mutation.



- Provide evidence that a mutation occurred from Figure A to Figure B. Explain the effect of the mutation on the resulting amino acid.
- Describe whether all mutations affect organisms and future generations in the same way. Explain your reasoning.

Scoring Guide for Constructed-Response Item 21

Score	Description
4	The student demonstrates a thorough understanding of the causes and effects of gene mutations. The response provides evidence that a mutation occurred and explains the effect of the mutation on the resulting amino acid. The response describes and explains that not all mutations affect organisms and future generations in the same way. The response has no errors or omissions.
3	The student demonstrates a general understanding of the causes and effects of gene mutations. The response has one error or omission.
2	The student demonstrates a limited understanding of the causes and effects of gene mutations. The response has errors or omissions overall.
1	The student demonstrates a minimal understanding of the causes and effects of gene mutations. The response has one piece of correct information.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 21

Part A: In the seventh base pair, a G was substituted (replaced) with a T. The mutation causes a change in the amino acid. The original amino acid is proline, but the mutation yields threonine.

Part B: Not all mutations affect organisms and future generations in the same way. The effect of mutations varies widely. Responses may indicate:

1. A mutation may be useful by altering the protein produced, which results in a beneficial adaptation. If the mutation is useful and is passed on, it will affect future generations.
2. A mutation may be neutral and may not change the amino acid specified by the genetic code.
3. A mutation may be harmful to the organism. If the mutation is detrimental and is passed on, it will affect future generations.

a.) A mutation occurred from figure A to B because one nucleotide from figure A changed from G to T. This represents a point mutation where only one nucleotide changes but it caused for the RNA to code for a different amino acid. The RNA in figure B coded for threonine as the third amino acid rather than proline.

b.) All mutations do not affect organisms and future generations in the same way. One amino acid change may not affect the organism at all because there are many more amino acids in an organism. This means it won't affect their offspring either. Some mutations such as a frame shift mutation may effect an organism because that would cause for all their amino acids to change which could affect them and future generations.

Summary annotation statement:

This response demonstrates a thorough understanding. Part A is correct; uses precise/accurate terms. Part B offers a description of different possible results of a mutation. Via context "All amino acids" refers to those in resultant protein.

a.) Figure A and Figure B both show similar structures of DNA, RNA, and amino acids, however there is a difference between the two structures relating to their amino acids. A mutation occurred from Figure A to Figure B because the structure in Figure A ends with G-C, G-C, and A-U, while Figure B ends with T-A, G-C, and A-U. The different pairs cause a different amino acid to be produced. Figure A produces Proline with its last three pairs, while the mutation in Figure B produces Threonine.

b.) All mutations do not affect organisms and future generations in the same way. The mutation in Figure B causes a different amino acid to be produced, but different mutations exist. A change in an organism's gene sequence does not always produce the same result. Some mutations can also benefit an organism or make the organism's life more difficult.

Summary annotation statement:

Part A: The response correctly identifies which base pair was mutated along with the amino acid change from proline to threonine.

Part B: The response correctly states not all mutations affect future generations in the same way, but only states generally that the mutation may not have an effect, or that it may benefit/make life more difficult. The response offers no specific examples or further explanation to support its statements.

A mutation in the DNA occurred when the 2nd G in the DNA swapped to T. Therefore it produced proline to threonine.

Not all mutations affect the organisms in a harmful way, but they will transfer more than likely to future generations.

Summary annotation statement:

This response shows limited understanding. Part A is complete. Part B is vague and receives no credit. Statements without support do not show meaningful understanding.

a. The mutation that has occurred was a change from proline to threonine. The gene is figure B. Would be different than the gene in figure A.

b. ^{Not} All mutations actually affect organism, although some mutations do, so it may or may not affect future generations.

Summary annotation statement:

This response shows minimal understanding. Part A describes the result of the mutation but not its location. Part B is inconclusive. It is vaguely true, but needs further explanation to earn credit.

A.) The amino acid sequence is different than sequence B because the Figure A has more DNA and RNA than figure B.

B.) It does change future generation because if you have more DNA from either your mom or dad. Things can change.

Summary annotation statement:

This answer is neither correct nor relevant. Part A demonstrates a common incorrect answer, and Part B is incorrect.

Constructed-Response Item 22

22. Earth is a suitable place for life because the atmosphere, geosphere, and hydrosphere provide conditions that make Earth habitable.

Describe four conditions that make Earth habitable. Explain how each of these four conditions is provided by the atmosphere, geosphere, or hydrosphere.

Scoring Guide for Constructed-Response Item 22

Score	Description
4	The response demonstrates a thorough understanding of the effect of Earth's systems on the habitability of Earth. The response describes <u>four</u> conditions that make Earth habitable, and explains how each condition is provided by the atmosphere, geosphere, or hydrosphere. The response has no errors or omissions.
3	The response demonstrates a general understanding of the effect of Earth's systems on the habitability of Earth. The response has one error or omission.
2	The response demonstrates a limited understanding of the effect of Earth's systems on the habitability of Earth. The response has two errors or omissions.
1	The response demonstrates a minimal understanding of the effect of Earth's systems on the habitability of Earth. The response has one correct piece of information.
0	The response is incorrect or contains some correct information that is irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 22

The response may include but is not limited to four of the following:

1. Fresh water supply is available for life:
 - Convection currents in the atmosphere cause precipitation and maintain a supply of fresh water (from salt water).
 - The water cycle in the atmosphere and hydrosphere maintain a supply of fresh water and maintain a relatively constant sea level.
 - Filtration of water in the geosphere helps maintain a supply of fresh water.
2. Oxygen and carbon dioxide are available for animals and plant life:
 - The atmosphere contains oxygen and carbon dioxide.
 - The geosphere supports trees (plants) which produce oxygen.
3. Temperatures on Earth are suitable for life (not too hot or too cold):
 - The atmosphere regulates Earth's temperatures by holding in some heat and radiating excess heat into space.
 - Convection currents in the hydrosphere (oceans) create weather and climates that are suitable for life.
4. Harmful UV radiation does not reach Earth's surface:
 - The atmosphere (ozone) prevents too much radiation from harming plants and animals.
5. Solar wind (containing radiation that is harmful to life) does not reach Earth's surface:
 - The geosphere (magnetosphere) prevents solar winds from reaching Earth's surface.
6. Earth's surface provides a substrate for plant life:
 - The geosphere contains rock and minerals that breakdown and become part of the soil.

Each description/explanation is worth 1 point each.

Earth is habitable because it has a good amount of oxygen in the Atmosphere. the oxygen partially comes from algae in the Hydrosphere that converts CO_2 into O_2 and release the O_2 into our atmosphere, allowing us to breathe. The availability of clean, fresh water allows us to live, the Hydrosphere and the water cycle keep a current of purification that waters our plants. Also in the geosphere large reservoirs filter the rain water more. Due to the Ozone layer of our atmosphere Earth manages to keep a habitable temperature by releasing the excess UV rays the planet is able to survive, and not be cooked. Essential minerals needed by the body is also found in the geosphere. These minerals seep into our water and keep our bodies running.

Summary annotation statement:

This answer includes four factors, tied to their correct ecosphere, with sufficient detail in the explanations to receive full credit.

1) The first condition is the existence of liquid water. Water is necessary for almost all life in order to build cells, perform photosynthesis, and other metabolic activity. The atmosphere provides moist air, and protects the earth from the sun's UV rays boiling off the oceans. The geosphere contains the water, and the hydrosphere is the water. 2) The second condition is the existence of oxygen in the atmosphere and in water. Oxygen is needed for cellular respiration to produce ATP giving most life energy. The Atmosphere is 20% oxygen, the hydrosphere contains O_2 dissolved in water, and oxygen is the #2 most abundant element in the earth's crust (geosphere). 3) The third condition is the existence of nitrogen compounds. Nitrogen is needed to make amino acids and all cells. They originated from volcanic vents in the geosphere, were collected in the hydrosphere, and contained by the atmosphere. 4) The fourth condition is earth's presence in the "habitable zone" where earth is close but not too close to the sun for water to be a liquid. Water is contained in the geosphere distributed by the atmosphere (rain) and is the hydrosphere.

Summary annotation statement:

This answer conveys a general understanding of the item. The response focuses on the ways in which the three ecospheres interrelate. Factors 1, 2, and 3 are reasonable with some level of detail in the explanation. For factor 4, Earth's location is not dependent on spheres. It is the other way around.

- A) Oxygen: we have oxygen because of the atmosphere and that's what keeps us alive.
- B) Water: All living organisms need water and earth is the only planet with this as well it is because of the hydrosphere.
- C) living organisms: us humans could not survive if it was only us on the earth. We need the animals and trees/plants to survive. This is why our geosphere can hold and support us.

Summary annotation statement:

This response received credit for oxygen and water. Biodiversity in the geosphere is incorrect.

The earth is habitable because of the vast forests which provide oxygen for the population of the world, and the ocean provide water food and travel from country to country. the atmosphere keeps oxygen in so we can breathe it every day to survive.

Summary annotation statement:

This response received credit for mentioning the atmosphere holding in oxygen. The reference to the ocean focuses on factors not necessary for habitability (travel).

Four conditions that make earth habitable are the seasons are a big part of what makes earth livable because Summer you get the bugs and animals coming out and the food chain keeps the population down. Winter kills off the bugs and grass and plants so they don't get over grown and there is fall when all the leaves change and Fall and decompose leaving a good fertilizer for the summer after winter passes and Spring the muddiest time of the year when the flowers grow back and the bugs come back. Making the cycle start all over again.

Summary annotation statement:

The student seems to have misunderstood the prompt; no credit was awarded.